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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/667,277	09/19/2003	C. Christopher Klepper		8651

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EXAMINER	
PERKINS, PAMELA E	

ART UNIT	PAPER NUMBER
2822	

DATE MAILED: 03/13/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

E) L

Office Action Summary	Application No.	Applicant(s)	
	10/667,277	KLEPPER ET AL.	
	Examiner	**Art Unit**	
	Pamela E. Perkins	2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 13 December 2005.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-48 is/are pending in the application.

4a) Of the above claim(s) 31 and 46-48 is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1,3-7,9-20,26,28,30,32-34 and 37-45 is/are rejected.

7)☒ Claim(s) 2,8,21-25,29,35 and 36 is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

This office action is in response to the filing of the request for reconsideration on 13 December 2005. Claims 1-48 are pending.

Information Disclosure Statement

The information disclosure statement filed 19 September 2003 fails to comply with 37 CFR 1.98(a)(1), which requires the following: (1) a list of all patents, publications, applications, or other information submitted for consideration by the Office; (2) U.S. patents and U.S. patent application publications listed in a section separately from citations of other documents; (3) ***the application number of the application in which the information disclosure statement is being submitted on each page of the list***; (4) ***a column that provides a blank space next to each document to be considered, for the examiner's initials***; and (5) ***a heading that clearly indicates that the list is an information disclosure statement*** *(emphasis added)*. The information disclosure statement has been placed in the application file, but the information referred to therein has not been considered.

Claim Objections

Claim 5 is objected to because of the following informalities: line 2 of claim 5 states "...consists only or boron ions ...". Appropriate correction is required.

Claim 30 is objected to because of the following informalities: line 1 of claim 30 states "...wherein a gas y be deliberately introduced...". Appropriate correction is required.

Claim 45 objected to because of the following informalities: line 1 of claim 40 states "...method of claiqm 1 wherein....". Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 14 and 38-40 are rejected under 35 U.S.C. 102(b) as being anticipated by Beck et al. (3,960,605).

Referring to claims 1, Beck et al. disclose a method of implanting boron ions into semiconductor materials at specified energies including providing a source of boron ions where the ions originate from solid boron material, and wherein the plasma is defined as a state of matter in consisting of ionized cores and free electrons with approximate overall charge neutrality in space, and streaming the ions against a target semiconductor material and thereby implanting them because of energetics suitable for penetration into the material (col. 2, lines 7-23).

Referring to claim 14, Beck et al. disclose the target is a silicon wafer (col. 6, lines 23-30).

Referring to claim 38, Beck et al. disclose wherein the beam may be deflected, steered, or confined by magnets of various geometries for the purpose of containment of plasma, directing the beam to the particular target, or separation of ions from macroparticles (col. 5, lines 11-21).

Referring to claim 39, Beck et al. discloses a method of providing boron ions for implantation into semiconductors by beam or plasma immersion and which requires no toxic carcinogenic, flammable, pyrophoric or explosive feed material of any kind, in particular, gaseous material (col. 2, lines 1-6).

Referring to claim 40, Beck et al. disclose the beam has one or more ion species added from one or more separate ion sources for purposes of growing compounds or growing semiconductor materials with the p-dopant grown in (col. 6, lines 23-30).

Claims 1, 3-5, 9-12, 14-16, 19, 28, 30, 33, 37-42 and 45 are rejected under 35 U.S.C. 102(b) as being anticipated by Booske et al. (5,672,541).

Referring to claim 1, Booske et al. disclose a method of implanting boron ions into semiconductor materials at specified energies including providing a source of boron ions or boron ion plasma where the ions or plasma originate from solid boron material, and wherein the plasma is defined as a state of matter in consisting of ionized cores and free electrons with approximate overall charge neutrality in space, and streaming the ions or plasma against a target semiconductor material and thereby implanting them because of energetics suitable for penetration into the material (abstract).

Referring to claim 3, Booske et al. disclose wherein the boron ions are produced and provided from a solid electrode of boron compound or boron composite material, such as boron carbide (abstract; col. 4, lines 28-35).

Referring to claims and 5, Booske et al. disclose a method of ion implantation doping wherein a plasma is 100% ionized and consists ions of other atomic species that have organized in a boron composite or boron compound electrode (col. 4, lines 54-60).

Referring to claim 9, Booske et al. disclose a method of streaming boron ions onto a target in which the total ion arrival rate or ion implantation rate, expressed as a total electric current impinging on the target material, is at least 0.3 amps or greater (col. 11, line 61 thru 12, line 5).

Referring to claim 10, Booske et al. disclose the technique of streaming the ions onto the target uses the principle of plasma source ion implantation which means that the target is biased relative to the plasma potential so that boron ions are extracted directly to the target from the plasma across the plasma sheath (col. 11, lines 27-33).

Referring to claim 11, Booske et al. disclose the boron ions are directed to the target by the technique of beam extraction from the plasma and then transport of said beam to the target over distances much larger than the plasma sheath (col. 11, lines 51-60).

Referring to claim 12, Booske et al. disclose a way to eliminate macroparticles from the ion stream so as to limit or eliminate impingement or macroparticles onto the target (col. 7, lines 43-53).

Referring to claim 14, Booske et al. disclose the target is a silicon wafer (col. 3, lines 58-60; col. 4, lines 46-48).

Referring to claim 15, Booske et al. disclose the target is diamond or contains diamond semiconductor material (col. 3, lines 58-60).

Referring to claim 16, Booske et al. disclose the target is silicon carbide (col. 3, lines 50-54).

Referring to claim 19, Booske et al. disclose wherein the boron ion doses and energies, together with any subsequent treatments, are designed to produce the result known as "p-doping" of the silicon or other semiconductor material (col. 4, lines 28 and 29).

Referring to claim 28, Booske et al. disclose a method of ion implantation of boron, wherein every process including steps of providing for generation of plasma and streaming of boron ions to the target are conducted with all components in a vacuum (col. 4, lines 44-48).

Referring to claim 30, Booske et al. disclose wherein a gas may be deliberately introduced into the stream of ions or plasma, possibly in the vicinity of the target, to provide for collisions with boron ions to help randomize the incident ion directions, produce a compound by reaction in the system, to reduce target sputtering by backscattering sputtered atoms, to produce cleaning of the target surface or the like (col. 7, lines 2-10).

Referring to claim 33, Booske et al. disclose a method of ion implantation of boron into semiconductor silicon in which the target is amorphized at boron doses

normally used for p-doping due to the extraordinary damage rate associated with the high temperature rate (col. 1, line 59 thru col. 2, line 15).

Referring to claim 37, Booske et al. disclose a method of ion implantation of boron into semiconductor material wherein there is neither a magnet provided nor magnetic separation of ions into atomic or isotopic species by mass analysis, nor are there any other ions or atoms co-implanted or impinging on the target surface as part of the process (col. 7, lines 41-43).

Referring to claim 38, Booske et al. disclose wherein the beam or plasma may be deflected, steered, or confined by magnets or magnetic Gelds of various geometries for the purpose of containment of plasma, directing the beam to the particular target, or separation of ions from macroparticles (col. 7, lines 43-53).

Referring to claim 39, Booske et al. disclose a method of providing boron ions for implantation into semiconductors by beam or plasma immersion and which requires no toxic carcinogenic, flammable, pyrophoric or explosive feed material of any kind, in particular, gaseous material (col. 4, lines 14-27).

Referring to claim 40, Booske et al. disclose wherein the beam has one or more ion species added from one or more separate ion sources for purposes of growing compounds or growing semiconductor materials with the p-dopant grown in (col. 7, lines 2-10).

Referring to claim 41, Booske et al. disclose wherein the beam is electrostatically deflected for separation of the beam from macroparticles and including the further step of mechanically trapping the macroparticles (col. 4, lines 54-65; col. 7, lines 41-53).

Referring to claim 42, Booske et al. disclose wherein the beam, after separation from the macroparticles, has its energy changed before impinging on the target surface (col. 11, lines 61-67).

Referring to claim 43, Booske et al. disclose wherein the plasma is reconstituted after a slowing down or lowering of energy of the beam (col. 11, lines 61-67.

Referring to claim 44, Booske et al. disclose wherein the reconstituted plasma is applied to the surface by the plasma immersion technique (col. 2, lines 40-43).

Referring to claim 45, Booske et al. disclose wherein the energy of deposition of the boron is so low as to result in a coating instead of an implantation p-doping of the target (col. 2, lines 60-62).

Claims 1, 14, 34 and 37 are rejected under 35 U.S.C. 102(b) as being anticipated by Obara et al. (6,562,705).

Referring to claim 1, Obara et al. disclose a method of implanting boron ions into semiconductor materials at specified energies including providing a source of boron ions or boron ion plasma where said ions or plasma originate from solid boron material, and wherein said plasma is defined as a state of matter in consisting of ionized cores and free electrons with approximate overall charge neutrality in space, and streaming said ions or plasma against a target semiconductor material and thereby implanting them because of energetics suitable for penetration into the material (abstract).

Referring to claim 14, Obara et al. disclose the target is a silicon wafer (col. 3, line 20).

Referring to claim 34, Obara et al. disclose a method of ion implantation of semiconductor silicon with boron wherein the target may be deliberately heated to a desired temperature by the implantation process due to the extraordinary rate of heat deposition resulting from the high rate of ion deposition (col. 4, lines 15-30).

Referring to claim 37, Obara et al. disclose a method of ion implantation of boron into semiconductor material wherein there is neither a magnet provided nor magnetic separation of ions into atomic or isotopic species by mass analysis, nor are there any other ions or atoms co-implanted or impinging on the target surface as part of the process (Fig. 4; abstract).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 6, 7, 13, 18, 20, 26, 27 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Booske et al. in view of Foad (5,977,552).

Booske et al. disclose the subject matte claimed above except the plasma plume is generated by a two-electrode vacuum arc system, known as a cathodic arc system and the firing and timing of the arc is stimulated by a triggering technique such as laser firing, an external electron gun or inducing a spark.

Foad discloses a method of ion implantation doping wherein a plasma is 100% ionized and consists only or boron ions and ions of other atomic species that have organized in a boron composite or boron compound electrode (col. 2, lines 40-51).

Since Booske et al. and Foad are both from the same field of endeavor, a method of ion implantation, the purpose disclosed by Foad would have been recognized in the pertinent art of Booske et al. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Booske et al. by the plasma plume is generated by a two-electrode vacuum arc system and the firing and timing of the arc is stimulated by an external electron gun as taught by Foad to provide high wafer processing speeds (col. 1, lines 53-57).

Referring to claims 6 and 7, Foad discloses wherein the plasma plume is generated by a two-electrode vacuum arc system by application of a suitable voltage between the electrodes with possible application of arc triggering techniques (col. 6, lines 35-58).

Referring to claim 18, Foad discloses the boron ion energies up to 200 keV (electron volts) (col. 5, lines 45-49). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Booske et al. by boron ion energies up to 200 keV as taught by Foad to provide high wafer processing speeds (col. 1, lines 53-57).

Referring to claims 26 and 27, Foad discloses wherein there is an arc in the vacuum space between the electrodes, and the firing and timing of the arc is stimulated by a triggering technique such as an external electron gun (col. 5, lines 61-64).

Referring to claim 13, Booske et al. do not disclose specific diameters of targets. It would have been obvious to one having ordinary skill in the art at the time invention was made to treat surface for targets of various sizes and up to 30 cm in diameter or greater disclosed in the claimed invention, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (CCPA 1955).

Referring to claim 20, Booske et al. disclose the claimed invention, including forming shallow junctions, except for the specified boron ion energy is selected in the range of 100 eV to 2 keV. It would have been obvious to one having ordinary skill in the art at the time invention was made to have the specified boron ion energy is selected in the range of 100 eV to 2 keV, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (CCPA 1955).

Referring to claim 32, Booske et al. disclose the claimed invention except for a plasma density up to $10^{12}/cm^3$ of boron ions. It would have been obvious to one having ordinary skill in the art at the time invention was made to have a plasma density up to $10^{12}/cm^3$ of boron ions, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (CCPA 1955).

Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Booske et al. in view of Protic et al. (4,415,916).

Booske et al. disclose the subject matter claimed above except the target is germanium or contains germanium semiconductor material.

Protic et al. disclose discloses a method of ion implantation doping wherein a plasma is 100% ionized and consists only or boron ions and ions of other atomic species that have organized in a boron composite or boron compound electrode (col. 1, lines 12-16).

Referring to claim 17, Protic disclose the target as germanium (col. 1, lines 12-16).

Since Booske et al. and Protic et al. are both from the same field of endeavor, a method of ion implantation, the purpose disclosed by Protic et al. would have been recognized in the pertinent art of Booske et al. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Booske et al. by the target as germanium as taught by Protic et al. to increase stability at high voltage (col. 1, line 51-55).

Allowable Subject Matter

Claims 2, 8, 21-25, 29, 35 and 36 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: Referring to claims 2, 8 and 21-25, prior art does not teach, suggest or disclose

wherein the boron ions are produced and provided by a plasma plume generated from an electrode of solid and pure boron.

Referring to claim 29, prior art does not teach, suggest or disclose wherein the vacuum precludes deliberate introduction any non-solid matter other than the plasma and ions originating in the solid electrode.

Referring to claim 35, prior art does not teach, suggest or disclose providing the necessary cooling or attenuating the implantation rate, as desired, to achieve the desired low temperature during implantation.

Referring to claim 36, prior art does not teach, suggest or disclose wherein the ions are first generated and then transported to the target by beam techniques in which the boron atoms are separated from the electrons of the plasma by electrostatic acceleration.

Response to Arguments

Applicant's arguments filed 13 December 2005 have been fully considered but they are not persuasive. As stated above, Beck et al. disclose the method of implanting boron ions as described in claims above.

In response to the applicant's arguments, the applicant argues Beck does not disclose “ions or plasma are pulled directly from the solid”. However, applicant does not claim the ions are pulled directly from the solid. In claim 1, applicant uses the term “comprising” as a transitional phrase which meaning of steps can be added in the claim. The transitional term “ comprising”, which is synonymous with “including,” “containing,”

or "characterized by," is inclusive or open-ended and does not exclude additional, unrecited elements or method step. See, e.g. *Mars, Inc. v. H.J. Heinz Co.*, 377 F.3d 1369, 1376, 71 USPQ2d 1837, 1843 (Fed. Cir. 2004).

Referring to claim 39, applicant argues claim 39 is a dependent claim and provides boron ions by beam or plasma immersion. However, in the claim set that the examiner received on 19 September 2005, claim 39 is written in independent form.

Applicant also argues Booske does ions of a non-reactive gas. However, Booske et al. disclose a method of implanting boron ions into semiconductor materials at specified energies including providing a source of boron ions or boron ion plasma where the ions or plasma originate from solid boron material, as disclosed in the abstract of the invention.

Referring to claim 5, applicant argues claim 5 is a dependent claim. However, in the claim set that the examiner received on 19 September 2005, claim 5 is written in independent form.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Abbott (6,239,440) disclose an arc ion implantation system.

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within

TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Pamela E. Perkins whose telephone number is (571) 272-1840. The examiner can normally be reached on Monday thru Friday, 8:30am to 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on (571) 272-2429. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Zandra Smith

Zandra V. Smith
Supervisory Patent Examiner
6 March 2006

PEP